

4.4.2 Regulating Reserve

Table 1
Summary of Costs Assigned to TBL for the Generation Input to Regulating Reserve

| Regulation | Average 2002-2006 (\$X000) Subtotals | Average 2002-2006 (\$X000) Totals |
|---|---|--|
| Costs Big 10 Dams | | |
| O&M | \$112,403 | |
| Depreciation | \$77,608 | |
| Net Interest Expense | \$101,220 | |
| Planned Net Revenues | \$48,919 | |
| Generation Integration (BPA Facilities) | \$8,000 | |
| A&G 1/ | \$33,902 | |
| Subtotal Revenue Requirement | \$382,052 | \$382,052 |
| | | |
| Fish and Wildlife 1/ | | |
| O&M | \$169,873 | |
| Depreciation | \$37,534 | |
| Net Interest Expense | \$37,371 | |
| Planned Net Revenues | \$18,070 | |
| Subtotal Revenue Requirement | \$262,847 | \$262,847 |
| | | |
| Total Big 10 Revenue Requirement | | \$644,899 |
| | | |
| Revenue Credits 1/ | | |
| 4h10C | \$42,012 | |
| Colville payment Treasury Credit | \$4,094 | |
| Reactive charge | \$22,899 | |
| Subtotal Revenue Credits | (\$69,005) | (\$69,005) |
| | | |
| Net Revenue Requirement | | \$575,894 |

Notes 1/ Big 10 share of costs (89%) and credits based on nameplate output.

TABLE 2
AGC ADDER ASSUMPTIONS

| | |
|----------|---------|
| million | 1000000 |
| thousand | 1000 |
| hours | 8760 |

| <u>Big 10 Capacity</u> | | <u>Turbine Type</u> | <u>Peak Eff</u> |
|-------------------------------|------------------|---------------------|-----------------|
| GCL | Grand Coulee | Francis | 5,467 |
| CHJ | Chief Joseph | Francis | 2,168 |
| JDA | John Day | Kaplan | 1,984 |
| TDA | The Dalles | Kaplan | 1,665 |
| BON | Bonneville | Kaplan | 841 |
| MCN | McNary | Kaplan | 706 |
| LGS | Little Goose | Kaplan | 730 |
| LMN | Lower Monumental | Kaplan | 706 |
| LWG | Lower Granite | Kaplan | 730 |
| IH | Ice Harbor | Kaplan | 658 |
| Francis Total Capacity | | | 7,635 |
| Kaplan Total Capacity | | | 7,360 |

TABLE 3
AGC ADDER CALCULATION

BPA Incremental Cost of Regulation (AGC)

Efficiency-Loss Costs of Regulation

(applied to all MW on AGC, not just MW of AGC capability)

| | <u>Kaplan</u> | <u>Francis</u> |
|---------------------|---------------|--------------------------------|
| Efficiency Loss | 0.25% | 0.29% on all kWh <u>on</u> AGC |
| kWh with Effic Loss | 8,760 | 8,760 kWh per kW-yr on AGC |
| kWh lost | 22 | 25 per kW-yr on AGC |
| Price (average) | 22.33 | 22.33 \$/MWh |
| Revenue Loss | \$0.49 | \$0.57 per kW-yr on AGC |

Incremental Increased O&M Costs of Regulation

(applied to all MW on AGC, not just MW of AGC capability)

| | <u>Kaplan</u> | <u>Francis</u> |
|---|---------------|--------------------------------|
| Base O&M Cost per kW of Francis & Kaplan Capacity | \$10.44 | \$6.65 \$/kW-yr |
| % O&M increase due to AGC(includes small capital) | 15% | 10% |
| Incremental O&M Cost for Regulation | \$1.57 | \$0.67 per kW-yr on AGC |

AGC Multiplier

(Calculate MW on AGC required to yield 1 MW of AGC response capability)

| | <u>Kaplan</u> | <u>Francis</u> |
|---------------------------------------|---------------|---|
| AGC multiplier* | 3.70 | 12.30 kW <u>on</u> AGC per kW <u>of</u> AGC response |
| *Per AGC Adder & Multiplier Worksheet | | |

Total Cost of Regulation

| | | | |
|-------------------------------------|------------------------------------|------------------|--------------------------------|
| Cost per kW-yr <u>on</u> AGC | | <u>Kaplan</u> | <u>Francis</u> |
| | Efficiency Loss Cost | \$0.49 | \$0.57 |
| | Increased O&M Cost | \$1.57 | \$0.67 |
| | | \$2.06 | \$1.23 |
| | | | per kW-yr <u>on</u> AGC |
| | (Multiply costs by AGC Multiplier) | 3.70 | 12.30 |
| Cost per kW-yr <u>of</u> AGC | | | |
| | Efficiency Loss Cost | \$1.81 | \$6.98 |
| | Increased O&M Cost | \$5.79 | \$8.18 |
| | Total AGC Incr. Cost | \$7.60 | \$15.16 |
| | MW*hours of AGC weight | 3,485,639 17% | 16,708,059 83% |
| | | | (FY'97 data) |
| | Weighted Average | \$13.85 | per kW-yr of AGC capability |
| | | or | |
| | | \$1.15 | per kW-month of AGC capability |

TABLE 4
AGC ADDER & MULTIPLIER WORKSHEET

Summary of Equipment (Francis Units)
Grand Coulee

6 Operated @ 73 MW
 ? eff = 0.3% (change in efficiency
 at an average operating point-from
 the unit operating curve)
 Range= 14 MW
 Multiplier = $73\text{MW}/14\text{MW} \times 2 = 10.4$

12 Operated @ 81 MW
 ? eff = 0.3%
 Range= 20 MW
 Multiplier = 8

3 Operated @ 600 MW
 ? eff = 0.2%
 Range= 95 MW
 Multiplier = 12.6

3 Operated @ 718 MW
 ? eff = 0.25%
 Range= 167 MW
 Multiplier = 8.6

Chief Joseph

11 Operated @ 88 MW
 ? eff = 0.33%
 Range= 9 MW
 Multiplier = 19.6

6 Operated @ 75 MW
 ? eff = 0.33%
 Range= 17 MW
 Multiplier = 8.8

10 Operated @ 75 MW
 ? eff = 0.5%
 Range= 7 MW
 Multiplier = 21.4

Calculations for Francis Units
Weighted Multiplier
(# units*MW*multiplier)

6 (73) 10.4 + 12 (81) 8
 + 3 (600) 12.6 + 3 (718) 8.6
 + 11 (88) 19.6 + 6 (75) 8.8
 + 10 (75) 21.4/WGTS = $92518/7532$
 = **12.3 Francis**

Weighted ? efficiency
(# units*? efficiency *multiplier)

6 (73) (3) + 12 (81) (3)
 + 3 (600) 2 + 3 (718) 2.5
 + 11 (88) 3.3 + 6 (75) 3.3
 + 10 (75) 5/WGTS = $21644/7532$
 = **.29% Francis**

Summary of Equipment (Kaplan Units)
Bonneville Dam 1st P.H.

? eff = **0.25% Kaplan**
 Range= 23.7MW
 Operated @ 43.7 MW

Multiplier = $43.7/23.7 \times 2 =$ **3.68 Kaplan**